

COVID-19 Vaccine Track and Traceability System

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Abstract

Logistics and supply chain play a very important role in business and industry these decades. Track and Traceability is one of the key components in making supply and chain more efficient. Furthermore, in Healthcare supply chain, Track and Traceability must be in place to ensure the safety of patients at the downstream. While all sectors in the world have the massive impacts from the COVID-19 pandemic, the world is starting to realize the importance of vaccine and it eventually becomes the only hope of the humanity. Hence, the vaccine supply chain becomes the major concerns in the Healthcare sectors. Temperature control throughout the supply chain activities e.g. storage, transportation and distribution are vital. Thus, not only tracking location and activity, temperature must also be monitored. Each of every vaccine has its own storage temperature in order to remain its quality and efficiency. One of the examples is our expectation COVID-19 vaccine. The sources reveal that the temperature storage range can be varied from -70 to 25 degree Celsius. From the authors' previous research, we identified problems about the supply chain and the certain requirement for the storage temperature of vaccine. Then, we invented the substitution of traditional ice pack used in nowadays' transportation to the liquid nitrogen cooling system. The research was concluded that liquid nitrogen has better performance in both terms of temperature stabilization and the period of time keeping temperature within desired range. However, our previous Vaccine Cold Box by Liquid Nitrogen did not have the ability to track and trace the location nor monitoring the temperature real time. Thus, in this study, an effort is made to develop the COVID-19 Vaccine Track and Traceability System. Firstly, the IOT system will be implemented. RFID tag with temperature sensor will be applied in the cold box. Then, the reader will collect the data and send to cloud server. At this point, the temperature data will be forwarded into two directions. One is to control the solenoid valve which is located in the cold box for releasing liquid nitrogen to the right amount wanted. Another is to display and collect the real time temperature at the Dash board for the temperature monitoring. Moreover, the previous study's calculation process has shown that there is another factor related to the length of time vaccine cold box could maintain temperature within range. It is the Thermal conductivity rate of the material used for the exterior of the cold box. We can easily increase the length of time by using the material with lower Thermal conductivity rate. After the cold box is built, we will set experiments to test the efficiency of the system, collect and analyze the data before the conclusion is reached.

Keywords

COVID-19 vaccine, track and trace, temperature monitoring and control, liquid nitrogen cold box, logistics

Biographies

Warattra Singkarin is a 10th grade high school student at Satriwithaya School Bangkok, Thailand. She has participated in the "New Brunswick International Student Program" at Dalhousie Regional High School, New Brunswick, Canada from 2019 to 2020. She has completed research project called "The Development of Vaccine Cold Box by Liquid Nitrogen for Temperature Control During Transportation" with Kwinyarut, Kunyapak, Suchaya, Sukonrat, PSA Chemtech Co. and Mahidol University. Warattra Singkarin has published conference paper and received silver metal at "The 1st International Conference for Students in Science and Innovation (ISSI)". Moreover, her project is now in the process of certifying Intellectual Property. Her research interests include Medical device invention, Logistics supply chain and Biomedical engineering.

Kwinyarut Pongsangthanakul is in grade 11 student and a president of the school's Science Club in Satriwithaya School, Bangkok Thailand. Her interests are Medical IOT and Device, Programming and Biomedical engineering. Working with Warattra, Kunyapak, Suchaya, Sukonrat, PSA Chemtech Co. and Mahidol University, she has

completed research project called “The Development of Vaccine Cold Box by Liquid Nitrogen for Temperature Control During Transportation”. The project is certifying for Intellectual Property and has earned silver metal at “The 1st International Conference for Students in Science and Innovation (ISSI)”. Additionally, she was selected to join in the “FIBO School Collaboration Project” at King Mongkut's University of Technology Thonburi in field of Medical IOT and Device.

Kunyapak Teekakun is a 11th grade student at Satriwithaya School, Bangkok Thailand. She has been selected to attend in the “Siriraj Hospital Medical Camp 21st” and “Dental Student Union of Thailand Open House 2019”. She has completed research project with the co-authors called “The Development of Vaccine Cold Box by Liquid Nitrogen for Temperature Control During Transportation” which later on has been published and gotten silver metal at “The 1st International Conference for Students in Science and Innovation (ISSI)”. Moreover, the project is now in the process of certifying Intellectual Property. Her topics of interests include Electronics and Biomedical engineering.

Pramote Namyang is a senior professional level teacher at Satriwithaya School. He holds a Bachelor of Science degree from Prince of Songkla University, Thailand and a Master of Education Program in Educational Technology degree from Kasetsart University, Thailand. He visited “Professional Development Programme for Secondary Science and Mathematics Educator SEAMOE RECSAM Gelugor” at Penang, Malaysia. Furthermore, he had been studying “Teaching STEM Method” at Michigan State University and The SUNY Cortland Campus in USA. Also, he has been to the “International Exhibition for Young Inventors 2013 (IEYI 2013)” at Kuala Lumpur, Malaysia. He has earned gold metal at “OBEC AWARDS 2013” and got 2rd place from being the advisor of the project called “Citrus grandis by using High Annealing Temperature- Random Amplified Polymorphic DNA”. He is a representative master teacher to show the “Academic Article and Release by Manuscript”.